The Connecticut Agricultural Experiment Station, New Haven

Specialty Crops: Okra, Leek, Sweet Potato, and Jilo

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SUMMARY

In 1998-2000, various cultivars of okra, leek, sweet potato, and jilo were grown at Windsor on a sandy terrace soil and at Mt. Carmel on a loamy upland soil.

In okra trials (1998), average cumulative yield of pods from seven cultivars was 43 pods/plant at Windsor compared to 49 pods/plant at Mt. Carmel. The cumulative yield of Emerald was greatest among all cultivars at Mt. Carmel (64 pods/plant) and Windsor (55 pods/plant). Cumulative yield of Annie Oakley II exceeded 50 pods/plant at Mt. Carmel and 45 pods/plant at Windsor.

In leek trials (1999), average yield of 10 cultivars of leek at Windsor was 16,510 lb/A compared to 9,970 lb/A at Mt. Carmel. Low average yield at Mt. Carmel was attributed to moisture deficits that persisted from June through August. The greatest yield among all cultivars was from medium-shanked Jersey at Windsor (22,070 lb/A) and at Mt. Carmel (13,000 lb/A). High yields were due to thick shanks that averaged 1.7 inches diameter with 13% exceeding 2 inches. The shanks of five long-shanked cultivars averaged
9.1 inches compared to 6.0 inches for two medium-shanked cultivars and 5.1 inches for three short-shanked cultivars. At Windsor, fully 65% of King Richard plants had shanks exceeding 12 inches.

In sweet potato trials (2000), average yield of eight cultivars was 17,800 lb/A at Windsor compared to 16,685 lb/A at Mt. Carmel. At Windsor, total yield of Georgia Jet was greatest (4.4 lb/plant) among all cultivars but 46% of the yield was split and unmarketable. Total yield of Beauregard, Jewel, and Bush Porto Rico exceeded 2.0 lb/plant with less than 9% split. Most of the yield of Bush Porto Rico (68%) and Vardaman (63%) was graded as canners. Most storage roots of both cultivars (110 day maturity) failed to reach U.S. #1 size grade when planted on May 28 and harvested in early October, a span of nearly 130 days.

In Jilo trials (1998-2000) at Windsor, cumulative yield of Teresopolis Gigante in rows covered with black plastic mulch (8.4 lb/plant) was 31% greater than cumulative yield from uncovered controls (6.4 lb/plant). At Mt. Carmel, cumulative yield in rows covered with black plastic mulch (11.0 lb/plant) was 15% greater than the yield in uncovered controls (9.6 lb/plant). Plastic mulch not only increased yield, but early yield in August was two-fold greater at both sites compared to uncovered controls. Harvest spans at both sites were 11-12.5 weeks.

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Important outlets for vegetables grown on Connecticut farms are direct sales at farm salesrooms, roadside stands and farmer's markets. Although the cash value through direct sales is unknown, the value of all vegetable crops in Connecticut has risen from $18.6 million (7.8% of all agricultural crops) in 1986 to $25.9 million (8.7%) in 1998, an increase of 30% (Anon 2000). Approximately 560 farms offer direct sales of a variety of vegetables, fruit, bedding plants, nursery stock, and Christmas trees (Anon 1989). About 120 are open all year. Nearly 30% of these direct marketers offer pick-your-own vegetables to reduce cost of harvest labor.

A fast-growing segment of direct sales is the establishment of a network of farmer's markets in Connecticut by the Connecticut Department of Agriculture. In 2000, there were 65 farmer's markets operating in urban and densely populated suburban centers. About 120 growers participated in these markets whose total cash receipts exceeded $1.2 million (Connecticut Department of Agriculture, personal communication). Farm-fresh produce is offered at reasonable prices to customers who cannot travel to outlying farms.

In 1998, the Connecticut Department of Agriculture conducted a survey of customers who purchased native-grown vegetables and growers who supplied them. Customer preference identified 73 specialty vegetables grown in Asia, Europe, and Central and South America. Growers requested information about cultivars, yields, and cultural methods for many of these vegetables. The most popular specialty vegetables included okra, leeks, and sweet potatoes. These crops have a high market value and an expanding market that readily accommodates these commodities. Jilo, an African eggplant, was added to the study to provide cultural information to growers in the Waterbury-Danbury area whose clientele includes a large number of Brazilian families that know and seek the crop.

We shall examine, individually, the yield, quality, and management of okra, leek, sweet potato, and jilo.

SOILS AND RAINFALL

Soils. All specialty vegetable trials (1998-2000) were conducted at the Valley Laboratory, Windsor, on Merrimac sandy loam, a well-drained terrace soil with somewhat limited moisture-holding capacity and at Lockwood Farm, Mt. Carmel (Hamden) on Cheshire fine sandy loam, a well-drained upland soil with moderate moisture-holding capacity.

Rainfall. Rainfall distribution throughout the growing season (April-October) for 1998-2000 is shown in Table 1. Rainfall in each column represents the departure from the 30-year mean monthly rainfall for Hartford (near Windsor) and Mt. Carmel reported by the National Weather Service. Total rainfall at Windsor during the 1998, 1999, and 2000 growing seasons was 29.4, 25.7, and 29.8 inches, respectively, compared to a 30-year average of 22.9 inches. Total rainfall at Mt. Carmel during the same period was 33.9, 24.2, and 32.7 inches, respectively compared to a 30-year average of 25.0 inches.

Although total rainfall in the 1998 growing season at Windsor was 6.6 inches above normal, deficits between 0.9 and 1.6 inches occurred in July, August, and September. At Mt. Carmel, total rainfall during the 1998 growing season was 11.0 inches above normal, but deficits of 2.2 and 1.8 inches occurred in July and September, respectively. In May through June total rainfall reached 15.5 inches at Windsor and 16.0 inches at Mt. Carmel. These totals, 9-10 inches above normal, delayed growth of okra and jilo transplants.

In 1999 at Windsor, total rainfall throughout the growing season was 2.8 inches above normal, but up to 2.8-inch deficits occurred from April through June and August. Rainfall, totaling 11.3 inches in September, nullified the

Table 1. Departure from normal rainfall (inches) during the 1998-2000 growing seasons (April - October) at Windsor and Mt. Carmel.

	WINDSOR				MT.CARMEL			
	30-Year Avg.	1998	1999	2000	30-Year Avg.	1998	1999	2000
April	3.9	-0.4	-2.7	1.6	4.0	1.2	-2.1	1.5
May	3.4	4.1	-1.0	1.4	3.7	2.3	-0.2	0.8
June	3.2	4.9	-2.8	3.2	2.5	7.5	-2.0	4.3
July	2.6	-0.9	1.4	2.8	3.2	-2.2	-2.1	4.7
August	3.4	-1.9	-0.7	-1.1	3.9	2.0	-1.8	-0.4
Sept	3.4	-1.6	8.5	1.0	4.2	-1.3	5.5	0.2
Oct	3.0	2.3	0.3	-2.1	3.3	0.2	2.1	-2.5

deficits and gave the growing season an appearance of normalcy. At Mt. Carmel, cumulative rainfall deficits of 8.3 inches from April through August created prolonged drought, especially in July and August when only 3.2 inches of rain fell. Severe drought and high temperatures severely stunted the growth of most crops and sharply reduced yields, especially of jilo whose flowers aborted in July and August. During September and October, 15.1 inches of rain fell but too late to impact yields.

In 2000 at Windsor, rainfall during the growing season was 6.9 inches above normal. Most of the excess occurred between April and July when 22.9 inches of rain fell, accompanied by lower-than-normal temperatures. August and October had deficits of 1.1 and 2.1 inches, respectively.

At Mt. Carmel, rainfall throughout the growing season was 7.8 inches above normal with 24.8 inches falling between April and July. Rainfall deficits occurred in August and October. Contrary to extremely dry 1999, the 2000 growing season was characterized by abundant water for excellent crop growth and yields at both sites.

OKRA TRIALS 1998

Okra (*Hibiscus esculentus*) is a member of the mallow family that is grown in all parts of the tropics and warmer parts of the temperate zone (Yamaguchi 1983). Its origin is thought to be in Africa or Asia, and it was brought to America by slaves in the early 1700's (Splittstoesser 1979). Okra is grown extensively in the South, but the development of cultivars with early maturity allows cultivation in the North. The woody shrub grows to heights of 3-6 feet and it is noted for its large yellow flowers. The edible pods that develop at leaf axils along the stem after the flowers fall are picked in the immature stage when they are tender. The most common uses are gumbo stew, soup, and fried in batter.

The leaves and pods are often spiny and cause allergic reactions in some users. The pods are smooth to ridged and light green, green, or purple in color. Okra is intolerant of poorly drained soils and those with a pH less than 6.0. (Maynard and Hochmuth 1997).

METHODS AND MATERIALS

Cultivars. Seeds were obtained from several domestic suppliers. They included Annie Oakley II, Burgundy, Cajun Delight, Clemson Spineless, Emerald, Green Best, and North & South.

Culture. Seeds were sown April 16 in Promix BX-filled 36-pot packs (3601's). Pots measured 2-5/8 X 2-1/4 X 2-5/16 inches and were placed in a greenhouse maintained at 70F at night and vented at 90F during the day. On May 16, the seedlings were moved to a cold frame for hardening. Water-soluble 20-20-20 fertilizer was added to the pots 1 week before transplanting in the field. On May 27-28, plants of each cultivar were transplanted 18 inches apart in rows 48 inches apart at each site. Each planting consisted of five blocks with the seven cultivars planted randomly within each block. There were six plants of each cultivar in each of the five blocks for a total of 30 plants.

Fertilizer. The soil at each site was fertilized with 5-10-10 at a rate of 1300 lb/A before transplanting. After 4 weeks, the plots were sidedressed with triple superphosphate at a rate of 50 lb/A.

Irrigation. June was excessively wet and the initial growth of the seedlings was very slow. July was excessively dry and the crop required two irrigations in the sandy soil at Windsor and one irrigation in the loamy soil at Mt. Carmel.

Harvest. Pods that developed at the base of axillary flowers were harvested when they reached about 3 inches in length, about 3-5 days after the flowers fell from the plant. When the plants were 2-3 feet tall, harvests were 3-4 days

Table 2. Cumulative yield of okra pods at Windsor and Mt. Carmel-1998.

	WINDSOR			MT CARMEL		
	Avg. pods/ plant* no.*	Avg. weight/ pod oz	Est. yield/ plant lb	Avg. pods/ plant no.*	Avg. weight/ pod oz	Est. yield/ plant lb
Annie Oakley II	49.1a	0.6	1.8	53.5a	0.6	2.0
Burgundy	31.6a	0.5	1.0	37.8a	0.5	1.2
Cajun Delight	45.3a	0.5	1.4	44.7a	0.5	1.4
Clemson Spineless	37.4a	0.7	1.6	46.3a	0.7	2.0
Emerald	54.6a	0.7	2.4	64.0a	0.7	2.8
Green Best	37.1a	0.5	1.2	48.5a	0.5	1.5
North & South	44.2a	0.5	1.4	50.4a	0.5	1.6

* Mean separation within columns by Tukey's HSD multiple comparison test at P=0.05.

Values in columns followed by the same letter did not differ significantly.

apart. As the plants grew taller, harvests were weekly. At weekly intervals, some pods grew too long and became tough and unpalatable. The pods were counted and weighed collectively in each replication.

YIELD

Harvest of pods began on July 7-8 at both sites and concluded October 19-20, a span of 15 weeks. Weekly yield of pods in early July, when the plants were 2-3 feet tall, was small (0.4 pods/plant) and reached a maximum in early September (7.9 pods/plant) as the plants reached 4-6 feet tall with numerous secondary branches. The average cumulative yield of the seven cultivars throughout the harvest season was 42.8 pods/plant at Windsor compared to 49.3 pods/plant at Mt. Carmel, a 15% difference. The greater yield at Mt. Carmel was due to greater retention of moisture in the loamy soil that produced larger plants compared to the somewhat droughty, easily leached soil at Windsor.

Although the cumulative yields (average pods/plant) among all cultivars were not significantly different at both sites, at Windsor, Emerald had the greatest cumulative yield (54.6 pods/plant), (Table 2). Annie Oakley II and Cajun Delight had cumulative yields exceeding 45 pods/plant. Burgundy (red pods) had the lowest yield (31.6 pods/plant) by virtue of its plant habit with fewer secondary branches.

At Mt. Carmel, Emerald had the greatest cumulative yield (64.0 pods/plant). Yield of pods from Annie Oakley, and North & South exceeded 50.0 pods/plant. Again, Burgundy had the smallest yield (37.8 pods/plant).

Since okra is sold by the pound in the marketplace, the average cumulative yield by weight is informative. Because most harvests were done weekly, some over-mature pods became large, fibrous, and of poor market quality. The average weight of 20 pods of marketable size and quality was determined for each cultivar. The estimated cumulative yields (lbs/plant) were determined by multiplying the average pods/plant X ounces/pod divided by 16 ounces/pound (Table 2). Cultivars with the greatest cumulative weight/plant were Emerald, Annie Oakley II, and Clemson Spineless at both sites. These cultivars had the tallest plants (5-6 feet) with many secondary branches. Emerald and Annie Oakley had high weight/plant because of a large number of pods/plant. Clemson Spineless high weight/plant was due to high weight/pod which compensated for lower pods/plant. The plants of Cajun Delight, Green Best, and North & South were smaller and more compact with fewer pods.

MANAGEMENT STRATEGIES

Planting. Since Okra grows tall and develops pod-producing side branches throughout the growing season, a single planting is sufficient. Transplants are essential to maximize yield. Direct seeding in May, after the soil warms, will delay the first harvest until mid-late August and shorten the harvest duration. The optimum time to plant okra, a heat tolerant plant, is mid-to-late May. Transplanting in early May leads only to sluggish growth as the soil begins to warm. Germination of the hard-coated seed is enhanced by soaking in warm water overnight (Splittstoesser 1979).

Harvest. A harvest interval of no longer than 3 days captures the tenderness of the pods. Pods become more fibrous and less palatable 4-5 days after flowers fall. Long exposure to spiny leaves and pods often evokes an allergic reaction. Skin irritation is diminished by wearing long-sleeved shirts and gloves.

Preferred cultivars. Although tested for only 1 year, trials at both sites showed that highest yields were attained by Emerald, Annie Oakley, and Clemson Spineless. The pods of Emerald are long and tapered with a smooth surface that

is bright green. The pods of Clemson Spineless are somewhat stocky with a deeply-ridged surface that is light green. The pods, heaviest among all tested, have thick walls. The pods of Annie Oakley II are of medium length with a ridged surface whose color is medium green. The pods of Cajun Delight, Green Best, and North & South are slightly ridged. The diameters of their pods are smaller and their walls are less thick. The pods of Burgundy are long and thin. The deep red color disappears during cooking.

Diseases. Plants at both sites became infected with verticillium wilt in early August. Many severely infected leaves fell from the plant. In early September, powdery mildew infected the plants and caused more leaves to drop at Mt. Carmel. Cultivars less affected by both diseases at each site were Emerald, Burgundy, Clemson Spineless, and Green Best (72-76% survival). In late September, survival rate of Annie Oakley II, Cajun Delight, and North & South, was 47-50% of the plants.

LEEK TRIALS 1999-2000

Leek (*Allium porrum*) is a biennial member of the onion family that does not form a prominent bulb. The thick fleshy stalks of leek are mostly used in soups and to enhance the flavor in mixed vegetable dishes and used raw in salads because of its mild flavor. Its origin is the Mediterranean area (Splittstoesser 1979). Leek is adapted to cold climates and may be over-wintered if mulched to prevent the soil from freezing. Winter harvests must be completed before vernalization causes the plants to bolt (forming a seedstalk) in spring (Yamaguchi 1983).

Although leek production in Connecticut is unknown, it is a popular vegetable in many home gardens because of its versatility in cooking.

MATERIALS AND METHODS

Cultivars. Seeds were obtained from several domestic suppliers. They included long-shanked cultivars King Richard, Splendid, Titan, Unique, and Primor; medium-shanked cultivars Jersey and Leefall; and short-shanked cultivars Carina, Electra, and Laura.

Culture. In 1999, three rows of seed were sown March 12 in shallow trays, 21 X 11 X 2.5 inches, filled with Promix BX and maintained in a greenhouse at 50-70F. The seedlings were lightly thinned to avoid overcrowding after they reached 2 inches in height. After 6 weeks, the seedlings were moved to a coldframe April 22 for hardening. Water soluble 20-20-20 fertilizer (1 tbsp/gal) was added to the seedlings about a week before transplanting. The planting at each site consisted of five replicated blocks, 10 X 20 feet, separated by a 3-foot aisle. On June 2-4, plants of all 10 cultivars were plucked from the seedling trays and transplanted, bare root, 6 inches apart in rows 36 inches apart, achieving a population of 20 plants/10-foot row or 100 plants of each cultivar in all five blocks. The rows for each cultivar were randomly selected within each block. The seedlings were planted about 2 inches deep in the soil.

In 2000, to improve the proportion of bleached shank, one-medium shanked and five long-shanked cultivars were planted in individual 40-foot rows. In half of each row, the transplants were set 2 inches deep, as in 1999. In the other half of the row, the plants were set 5 inches deep in holes formed with a dibble. The tops of the 8-inch transplants protruded about 3 inches above the soil. The holes were incompletely backfilled. Eventually, the holes filled with soil washed in by rainfall and cultivation.

Fertilizer. In 1999 and 2000, the soil at both sites was fertilized with 1200 lb/A 10-10-10 before transplanting. The rows were sidedressed with 90 lb/A ammonium nitrate about 4 weeks after transplanting. Fertilization supplied a total of 150 lb/A nitrogen to the growing crop. The pH of the soil was 6.5 at both sites and did not require lime.

Weed control. Weeds were controlled by cultivation in both years.

Insect control. Root maggots were controlled by Lorsban 4E (chlorpyrifos) at a rate of 1.1 ounce/1000 feet of row, applied as a soil drench immediately after transplanting.

Irrigation. During dry 1999, both sites received three irrigations (1.0 inch), one immediately after transplanting. In 2000, both sites were irrigated once (0.25 inches) immediately after transplanting.

Harvest. Mature leeks were harvested September 25-October 8 at Windsor and September 22-October 7 at Mt. Carmel. All cultivars in each replication were harvested in a single day, The root systems of the harvested leeks were severed and the outer 1 or 2 whorls of leaves encasing the shank were removed. Some of these leaves were partially desiccated, split, or pitted with lesions of soft rot. The plants were then trimmed to 12 inches. The shanks were measured from the base of the plant to a point where the first leaves fanned out from the shank. The diameter of the shank was measured 2 inches above the base of the plant to avoid the slightly bulbed area at the base of some cultivars.

YIELD—1999

The average estimated yield of 10 cultivars of leek at Windsor was 16,510 lb/A compared to 9,770 lb/A at Mt. Carmel, a 69% difference (Table 3). Lower average yield at

Table 3. Characteristics and yield of trimmed leeks (12") grown at Windsor and Mt. Carmel in 1999.

	WINDSOR					MT. CARMEL				
	Hvst %	Avg. Shank dia.* in.	Avg. Shank length* in.	Avg. wt./ plant* oz.	Total yield** lb./A	Hvst %	Avg. Shank dia* in.	Avg. Shank length* in.	Avg. wt./ plant* oz.	Total yield** lb./A
					LONG-SHANKED					
King Richard	85	1.4b	10.6a	8.8b	15,935	92	1.0b	10.0a	5.5b	9,200
Primor	89	1.4b	7.9b	10.2b	16,520	98	1.0b	5.8b	6.4b	11,455
Splendid	93	1.3b	9.2b	8.4b	14,160	93	1.0b	7.4b	5.5b	9,300
Titan	86	1.3b	9.3b	9.1b	14,190	96	1.0b	7.0b	5.4b	9,390
Unique	90	1.4b	8.6b	9.6b	15,730	90	1.0b	6.4b	5.6b	9,080
					MEDIUM-SHANKED					
Jersey	90	1.7a	6.2bc	13.5a	22,070	92	1.2a	5.4b	7.4a	12,995
Leefall	97	1.3b	5.7c	10.1b	17,780	94	1.0b	5.4b	5.8b	9,505
					SHORT-SHANKED					
Carina	95	1.4b	5.1b	10.0b	17,275	94	0.9b	4.6bc	4.5b	7,695
Electra	94	1.4b	5.0c	10.7b	18,185	93	1.1ab	4.7bc	6.8ab	11,570
Laura	95	1.2bc	5.2c	7.7bc	13,260	90	0.9b	4.3bc	4.6b	7,500

*Mean separation within columns by Tukey's HSD multiple comparison test at P=0.05.

Values in columns followed by the same letter did not differ significantly.

**Based on 29,040 plants/A (0.5 x 3.0 foot spacing) x ounces/plant x % harvested ÷ 16.

Mt. Carmel was due to moisture deficits that persisted from June through August. Irrigation was insufficient to make up for the deficits. At Windsor 4 inches of rain throughout July provided sufficient water to maintain normal growth.

At Windsor, the cultivar Jersey had the greatest estimated yield (22,070 lb/A) among all cultivars. Although the shank was of medium length, its diameter was significantly greater among all cultivars and provided significantly greater weight/plant. The plant weights of short-shanked Carina, and Electra were also above average. The heavier average weights were mostly attributed to the leafy material that fanned out above the shank. Athough the estimated yield of all long-shanked cultivars was at or below average, much of the weight was contributed by the shank, the usable portion of the leek plant. The shank length of the five long-shanked cultivars averaged 9.1 inches compared to 6.0 inches for the two medium-shanked cultivars and 5.1 inches for the three short-shanked cultivars. At Windsor, fully 65% of King Richard plants had shanks exceeding 12 inches while over 25% of Titan and Splendid had shanks exceeding 12 inches.

Average shank diameter among all cultivars, except Jersey (1.7 inches), was 1.2-1.4 inches. Thirteen percent of Jersey had a shank diameter that exceeded 2.0 inches.

At Mt. Carmel, prolonged drought slowed plant growth. The average shank diameter in all cultivars was 0.4 inches less and the shank length 0.8 inch shorter, and the weight/plant 4 ounces less than those at Windsor. Jersey, again, had significantly greater shank diameter (1.2 inches) compared to all others (0.9-1.1 inches). The average shank length of King Richard was 10.0 inches with 24% of plants exceeding 12 inches. Jersey had significantly greater average weight/plant (7.4 ounces) among all cultivars and greatest total yield (12,995 lb/A). The estimated yield of long-shanked Primor and short-shanked Electra exceeded 11,000 lb/A, but most of Electra's weight was coarse leafy material rather than the edible shank.

MANAGEMENT STRATEGIES

Selection of cultivars. Cultivar selection depends largely on the display of leeks in the market. Most leeks are displayed with some green leaves fanning out at the top. If leeks are trimmed to 12 inches, long-shanked cultivars may have too few green leaves showing and short-shanked cultivars have too many green leaves. If the leeks are to be pureed in soup, the greatest amount of edible shank is preferred. Long-shanked and medium-shanked cultivars provide the greatest amount of edible material. If trimmed to a uniform length of 12 inches, most of King Richard, Splendid, and Titan is edible. Long-shanked Primor has 80% of its shank edible and their 1.4-inch diameter shanks are topped with a short display of leaves. Although the shanks

Table 4. The effect of deep (6-inches) vs. shallow (2-inches) planting of leek transplants on average percent plant survival, harvest weight (trimmed) and proportion of blanched shanks at Windsor.

	6-INCH DEPTH					2-INCH DEPTH				
	Hvst. %	Wt oz.	Shank Lgth. in.	Blan. Lgth. in.	Blan. Prop. %	Hvst. %	Wt. oz.	Shank Lgth. in.	Blan. Lgth. in.	Blan. Prop %
King Richard	95	7.1	10.6	3.2	30	98	8.1	10.9	3.4	31
Primor	98	8.5	7.8	3.8	49	92	9.4	9.0	3.3	37
Splendid	98	6.1	8.7	3.1	36	98	9.5	9.4	3.5	37
Titan	92	5.6	10.1	5.1	50	95	6.6	11.1	3.2	29
Unique	95	7.8	8.4	5.7	68	95	7.3	8.3	3.7	44
Jersey	88	7.5	5.9	4.0	68	100	11.9	6.5	3.9	60

of Jersey average 6.2 inches long, its great thickness provides ample edible material. Although the short-shanked Carina, Electra, and Laura display well, their edible shanks are only about 40% of their total trimmed weight. Although the largest proportion of the weight of Electra is derived from coarse leaves, its display is appealing.

Planting. The visual appeal of leeks in the market and its superiority in taste is the bleached portion of the shank. Generally, most long-shanked cultivars are described as "self-blanching." The removal of the outermost whorls of leaves exposes interior leaves that range in color from very pale green to white. To increase the blanched portion of the shank, transplants are generally planted in a shallow trench 3-4 inches deep. The trench is gradually filled during subsequent hoeings and then hilled around the base of the plant as they continue to grow (Ferro, et. al. 1989). Alternatively, the 6-8-inch transplants may be placed in dibbled holes, 5-6 inches deep, exposing only 2-3 inches of the top. The holes are not completely back-filled with soil but allowed to fill gradually with soil washed in by rain or irrigation. Does this alternative method improve the length of the blanched portion of the shank compared to standard planting at 3 inches? Tests at Windsor revealed that dibbled planting had little effect on plant survival. Average plant survival among the six cultivars tested was 94% for dibbled planting compared to 96% for shallow planting (Table 4). Deeper burial of the stems did not increase the incidence of stem rot. Plant mortality of Jersey was 12% under deep planting with a dibble. The average trimmed plant weight of the six deeply-planted cultivars was 7.1 ounces compared to 8.8 ounces for shallow-planted cultivars, a difference of 19%. The reduction in weight of deeply-planted cultivars was calculated as a loss of 2,650 lb/A, an economic disadvantage. Average shank length for deeply-planted cultivars was 8.6 inches compared to 9.2 inches for shallowly-planted cultivars. Although the average shank length decreased, the blanched portion of the shank increased from 3.5 inches to 4.2 inches in deeply-planted cultivars. The blanched portion of the stem increased from 40% of the shank in shallowly-planted cultivars to 50% in deeply-planted cultivars. The blanched portion of Titan and Unique exceeded 5.0 inches when deeply planted.

In summary, deep planting of transplants moderately decreased shank length and total yield but increased the blanched portion of the shank and created a more attractive product.

Storage. Leeks may be stored at 32F and 90-95% relative humidity for 1-3 months. (Splittstoesser 1979).

SWEET POTATO TRIALS 1999-2000

Sweet potato (*Ipomoea batatas*) originated in Central and South America. It was taken to Europe by Columbus. Its first recorded use in the United States was in the early 1600's (Splittstoesser 1979). In the South, the sweet potato is also called yam, but both are identical species. The name "nyami" was used by African slaves to describe the newly-found root that was similar to the true yam (*Dioscorea spp.*) that was cultivated in Africa. The sweet potato is a perennial with long vines and flowers that resemble morning glories (Yamaguchi 1983). The edible portion is a storage root that enlarges as daylength shortens in late summer.

In the United States, North Carolina and Louisiana are the leading producers. They are available year around because they can be cured and stored for up to 6 months.

Table 5. Yield (ounces/plant) of sweet potatoes grown at Windsor and Mt. Carmel—2000.

	Hvst %	Jumbo + U.S.#1 oz.	Canners oz.	Split oz.	Total oz.	yield* lb./A	40-lb. crates no./A
			WINDSOR				
Beauregard	90	28.2	7.2	1.4	36.8	19,700	432
Carolina Ruby	96	3.5	8.6	0.0	12.1	7,965	58
Georgia Jet	88	33.4	4.9	32.4	70.7	22,940	500
Jewel	98	24.9	7.6	3.2	35.7	21,655	415
Porto Rico	98	10.1	22.4	0.5	33.0	22,190	181
Vardaman	100	7.6	18.2	4.0	29.8	20,295	129
White Triumph	54	16.2	9.0	2.4	27.6	9,255	149
			MT. CARMEL				
Beauregard	94	37.2	7.0	2.7	46.9	28,995	598
Carolina Ruby	91	5.1	10.4	0.0	15.5	9,615	79
Georgia Jet	94	19.7	6.5	27.5	53.7	16,820	316
Jewel	96	18.6	8.9	1.0	28.5	18,000	304
Porto Rico	93	13.0	14.0	1.7	28.7	17,130	206
Vardaman	96	10.9	9.3	8.2	28.4	13,190	178
White Triumph	78	9.2	15.4	3.6	28.2	13,040	122

* Total marketable yield (Jumbo + U.S.#1 + Canners) = wt./plant x 10,890 plants/A (1' x 4' spacing) x % plants producing.

Among all vegetables, sweet potato is very high in nutritive value. It is high in carbohydrates, beta carotene (provitamin A) and vitamin C.

METHODS AND MATERIALS

Cultivars. Vegetative slips of Beauregard, Georgia Jet, Jewel, Bush Porto Rico, Vardaman, and White Triumph were obtained from a domestic supplier. Carolina Ruby was obtained from a Massachusetts grower and has limited availability at this time. This cultivar was recently developed at North Carolina State University. Its female parentage is highly productive Beauregard crossed with an unknown red-skinned variety, producing a highly productive red-skinned progeny (Collins, et al. 1999).

Culture. Preliminary trials were conducted in 1999 at both sites. Two 50-foot rows were planted with Beauregard. One row was hilled to 10 inches, the other unhilled. Half of each row was covered with 1.5 mil black plastic mulch. The slips were planted 12 inches apart in rows 48 inches apart.

In cultivar trials in 2000, single 50-foot rows were planted with each cultivar at each site. All rows, unhilled, were covered with 1.5 mil black plastic mulch. The slips were planted 12 inches apart in holes cut through the plastic. The rows were 48 inches apart. In 1999, the slips were planted June 2-10; in 2000, May 29- June 1. Late-arriving Carolina Ruby was planted June 29-30 at both sites.

Fertilizer. The soil at both sites was fertilized with 10-10-10 at a rate of 1300 lb/A before the plants were transplanted.

Irrigation. In dry 1999, the plots were irrigated three times at Windsor and two times at Mt. Carmel. In wet 2000, the plots were irrigated only once at each site, shortly after transplanting.

Harvest. In 1999 and 2000, sweet potatoes were harvested at both sites September 23-October 10 and September 11-October 16, respectively. Fully 60% of the harvest occurred in both years before October 8-9 frosts. The harvested sweet potatoes were graded according to USDA standards as follows:

- Jumbo: Greater than 3.5 inches diameter and 9 inches length.
- U.S. #1: 2-3.5 inches diameter and 3-9 inches length.
- Canners: 1-2 inches diameter and 2-7 inches length.

Split roots were weighed and discarded. Roots smaller than 1-inch diameter or less than 2-inches long were not weighed and were discarded.

YIELD 2000

Average marketable yield of seven cultivars of sweet potatoes was 17,800 lb/A at Windsor compared to 16,685 lb/A at Mt. Carmel, a 7% difference (Table 5). At Windsor the total yield of Georgia Jet was greatest (4.4 lb/plant) among all cultivars but 46% of the yield was split and unmarketable. Total yield of Beauregard, Jewel, and Bush

Table 6. Yield of Beauregard sweet potatoes grown in raised vs. unraised, covered vs. uncovered beds at Windsor and Mt. Carmel, in 1999 and 2000

	WINDSOR		MT.CARMEL	
	1999 Yield lb./plant	2000 Yield lb./plant	1999 Yield lb./plant	2000 Yield lb./plant
Covered & raised	2.5	--	3.1	--
Covered & unraised	4.7	2.3	4.0	2.9
Uncovered & raised	4.2	--	2.4	--
Uncovered & unraised	5.0	3.9	2.6	3.1

Porto Rico exceeded 2.0 lb/ plant and less than 9% of each was split and unmarketable. Most of the yield of Bush Porto Rico (68%) and Vardaman (63%) was graded as canners.

At Mt. Carmel, the total marketable yield of Georgia Jet was greatest (3.4 lb/plant) among all cultivars, but 51% of the total yield was split and unmarketable. Total yield of Beauregard was 2.9 lb/plant but only 6% was split. Total yield of Jewel, Bush Porto Rico, Vardaman, and White Triumph was remarkably uniform (1.8 lb/plant). Vardaman, however, had 28% of its yield split.

Yield of Jumbo and U.S.#1 roots of Georgia Jet at Windsor and Beauregard at Mt. Carmel exceeded 500 40-lb crates/A (Table 5). At Windsor, yield of Jumbo and U.S.#1 roots of Beauregard and Jewel exceeded 400 40-lb crates/A. At Mt. Carmel, yield of Georgia Jet and Jewel exceeded 300 40-lb crates/A.

MANAGEMENT STRATEGIES

Selection of cultivars. Beauregard, at this time, is the cultivar of choice. The plants are not only highly productive but they produce early yields by virtue of their early maturity (90 days). In 1999 preliminary trials, plants of Beauregard commonly yielded 4-5 lb/plant. These plants bore 4-6 storage roots that graded U.S.#1. A small trial of Carolina Ruby in 1999 also revealed its high productivity. Its 4-6 red-skinned storage roots/plant were centrally located beneath the planting site. Beauregard, at times, produced marketable roots 1-2 feet from the planting site, especially in rows covered with black plastic mulch. This feature required more extensive digging.

Georgia Jet also had high yields, but the storage roots often cracked if exposed to sudden changes in water availability. Split roots quickly heal, but their unsightly appearance reduces marketability. Yield of Jewel was lower than Beauregard and Georgia Jet, but their quality is excellent with little cracking. Yields of White Triumph, Vardaman, and Bush Porto Rico were low in comparison to all others. Bush Porto Rico, however, has short vines (2.9 feet) which would appeal to home gardeners with limited space. Beauregard, whose yield was greatest, had the longest vines that averaged 6.7 feet in length.

Planting date. Most purveyors of vegetative slips offer a range of shipping dates to accommodate growers in northern climates. In 1999 and 2000, planting in late May provided ample growing time to produce satisfactory yields for early maturing cultivars (90 days). This planting date, however, did not allow Vardaman, Bush Porto Rico, and White Triumph sufficient time to reach their fullest yield potential even after 130 days. Although untested, an earlier planting date (May 10-15) may improve yields of these late-maturing cultivars (110 days). It is known that most of the storage in Bush Porto Rico occurs during the last 4-5 weeks of its growth (Yamaguchi 1983). In 2000, marketable yield of Carolina Ruby was low at Windsor (0.8 lb/plant) and Mt. Carmel (1.0 lb/plant) due to its late planting (June 27-30). Only 29-32% of the yield reached U.S.#1 size. Most roots were graded canners. Because this cultivar has a 3-5-day earlier maturity than Beauregard (Collins, et al. 1999), a late-May planting date would have improved yield.

Plant spacing. Although the within-row spacing during the trials was 12 inches between plants, studies at North Carolina State University found that Beauregard, planted 9 inches apart, had the greatest yield 110 days after transplanting (Schultheis, et al. 1999). A 9-inch spacing within rows produces a plant population of 14,185 plants/A if rows are 48 inches apart compared to a population of 10,890 plants/A at a 12-inch spacing, a 30% increase. Spacing between rows of Bush Porto Rico can be reduced to 36 inches because of its short vines.

Site preparation. Planting instructions from growers that supply slips recommend site preparation that may include preparing hilled rows and/or covering the rows with black plastic mulch. Hilled rows are especially useful if the subsoil is clayey or compact with impeded drainage. Hochmuth and Howell (1983) found that covering raised beds with black plastic mulch increased soil temperatures and subsequent yield of Jewel, a cultivar maturing in 120 days. Forming hilled rows and covering them with plastic is an added expense of labor and material. To test whether either management practice is necessary in Con-

necticut, Beauregard, a cultivar maturing in 90 days, was grown at both sites in 1999 and 2000. In 1999 at Windsor, flat rows, covered or uncovered, had greater yields than hilled rows, covered or uncovered (Table 6). At Mt. Carmel, flat rows covered with plastic mulch had greater yields than all other combinations. In 2000, uncovered flat rows had greater yields than covered flat rows. It appeared that forming hilled rows for culture of early-maturing Beauregard was unnecessary in well-drained sandy and loamy soils in Connecticut. The use of black plastic did not increase yields consistently, but its value in controlling weeds within the planted rows and reducing leaching of fertilizer cannot be discounted. A disadvantage of black plastic mulch is its tendency to provide cover for nesting field mice and voles. At both sites in 1999 and 2000, an estimated 2-3% of the roots was damaged by rodents.

Curing and storage. If harvested roots are destined for long-term storage, curing is essential. Proper curing occurs at temperatures of 80-85F at 85-90% relative humidity for 4-7 days (Yamaguchi 1983). Curing heals wounds on the surface of the skin and forms a corky layer, which prevents penetration by disease organisms and slows water loss. After curing, the roots are stored at 55-60F and 85-90% relative humidity (Yamaguchi 1983). With proper curing and storage, many cultivars maintain their quality and taste for up to 6 months. If storage temperatures fall below 50F, chilling injury (internal discoloration and pitting of the surface) occurs and reduces the quality of the roots and their taste. During curing and storage substantial changes occur in the stored carbohydrates. Total sugars increase from 3.0 to 6.5% in roots stored up to 3 months (Morris and Mann 1955).

JILO TRIALS 1998-2000

Jilo (*Solanum gilo*), also known as gilo, is a solanaceous plant akin to eggplant. This tropical vegetable is grown principally in Nigeria. Its culture was transported to central and southern Brazil where it became a minor crop (Yamaguchi, 1983). Its principal use is in vegetable stews (ratatouille) and sweet and sour mixes with chicken and pork.
A member of the Brazilian community in the Danbury-Waterbury area, (estimated to exceed 4,300 families) approached a Bethel grower and asked him to grow the crop. Seeds were imported from Brazil and given to him for testing in Connecticut's climate. The Connecticut Department of Agriculture obtained some of the seeds and sent them to The Connecticut Agricultural Experiment Station for further testing. This section reports the yield, quality, and cultural requirements of this crop.

Cultivars. In 1998, one cultivar, Terresopolis Gigante was obtained from Brazil through the Connecticut Department of Agriculture. In 1999 and 2000, Comprido Verde Claro was added from a domestic supplier.

Culture. Seed was sown March 10-18 in 36-pot packs, each pot 2-5/8 X 2-1/4 X 2-5/16 inches (3601's), filled with Promix BX and placed in a greenhouse maintained at 70-90F. On May 16-21 the seedlings were moved to a coldframe for hardening. Water-soluble 20-20-20 fertilizer was added to the seedlings 4-7 days before transplanting in the field. On May 22-June 7, the seedlings were transplanted 24 inches apart in rows 36 inches apart (1998) or 48 inches apart (1999, 2000). In 1998 at Mt. Carmel, two 50-foot rows were planted with Teresopolis Gigante; at Windsor rows were 40 feet long, a population of 25 and 20 plants, respectively. At each site, one row was covered with a 36-inch wide black plastic mulch (1.5 mil), the other row was an uncovered control. In 1999 and 2000, two 50-foot rows were planted. Each row contained 12 plants each of Teresopolis Gigante and Comprido Verde Claro. The cultivars were separated by a 4-foot gap within the row. One 50-foot row was covered with black plastic mulch and the other was uncovered.

Fertilization. The soil at each site was fertilized with 10-10-10 at a rate of 1300 lb/A (30 lb/1,000 square feet) before transplanting. The pH at both sites was 6.5 and did not require lime.

Harvest. Fruit, borne singly or in clusters of 2 or 3, were harvested in the immature green stage as they reached 2-3 inches in length. As the fruit matured, the color changed from green, to yellow, to orange, to bright red. The fruit also became progressively more bitter as it matured. Harvests were 7 days apart until late October. In mid-to-late October light frosts injured the uppermost leaves of most plants but did not injure the fruit. In 2000 at Mt. Carmel, the last harvest occurred November 6.

YIELD

In 1998, harvest of jilo began August 4 at both sites and continued until October 30, a span of 12.4 weeks. At Windsor, total cumulative yield of Teresopolis Gigante in rows covered with black plastic mulch was 31% greater than the yield from plants in uncovered rows (Table 7). At Mt. Carmel, total cumulative yield of Teresopolis Gigante in rows covered with black plastic mulch was 15% greater than the yield in the uncovered row. At Windsor, yields in the covered row (8.4 lb/plant) and uncovered row (6.4 lb/plant) were lower than the yields in the covered row (11.0 lb/plant) and uncovered row (9.6 lb/plant) at Mt. Carmel because of water deficits in July through September (Table 1). In August, the jilo plants at Mt. Carmel were

Table 7. Yield of Jilo (lb./plant) grown at Windsor and Mt. Carmel 1998-2000. + indicates with mulch, - indicates no mulch.

	WINDSOR					
	1998		1999		2000	
	+	-	+	-	+	-
Comprido Verde Claro	--	--	--	--	10.7	8.2
Teresopolis Gigante	8.4	6.4	--	--	8.3	8.5
	MT. CARMEL					
	+	-	+	-	+	-
Comprido Verde Claro	--	--	2.6	2.2	6.1	4.4
Teresopolis Gigante	11.0	9.6	1.6	1.9	6.2	5.3

about 4 feet tall compared to 3 feet tall at Windsor.

At both sites, plastic mulch not only increased yield but also earliness of harvest. Although harvest of fruit from covered and uncovered rows began on the same date (August 4) at both sites, yield from covered rows was more than twice the yield from uncovered rows. After mid-September, yield from uncovered rows finally began to exceed yield from covered rows. Early-August yields in covered and uncovered rows at Windsor exceeded yield in covered and uncovered rows at Mt. Carmel two-fold. This is not surprising because the sandy soil at Windsor warms faster than the loamy soil at Mt. Carmel, and early growth of plants was greater. The early growth advantage at Windsor was lost by late August.

In 1999, yields at Mt. Carmel (Table 7) were primarily affected by persistent drought from April through August (Table 1). Flowers that developed soon aborted. No fruit were set from late July through August. The first fruit were harvested September 17 and harvest concluded October 21, a 5-week period. Yields of Teresopolis Gigante and Comprido Verde Claro were less than 2.6 lb/plant with or without cover.

In 2000, with ample rain, yields increased at both sites, compared to 1999. The first harvests of fruit were August 10-11 at both sites and concluded October 26 at Windsor and November 6 at Mt. Carmel, an 11-week and 12.5-week period, respectively. At Windsor, average cumulative yield/plant of Comprido Verde Claro, covered with black plastic mulch was 30% greater than the average cumulative yield/plant in unmulched plants (Table 7). Average cumulative yield/plant of Teresopolis Gigante was virtually the same in covered and uncovered plants.

At Mt. Carmel, average cumulative yield/plant of Comprido Verde Claro was 39% greater in mulched plants compared to unmulched plants. Average cumulative yield/plant of Teresopolis Gigante was 17% greater in mulched plants compared to unmulched plants.

Mulched plants also provided earlier yields for both cultivars compared to unmulched plants. By September 6, 61% of the total yield of mulched plants of Teresopolis Gigante had been harvested compared to 50% in unmulched plants. During the same time, 55% of the total yield in mulched plants of Comprido Verde Claro had been harvested compared to 52% in unmulched plants.

In summary, jilo mulched with black plastic usually increased yield substantially and provided earlier yields compared to yields in unmulched plants.

MANAGEMENT STRATEGIES

Selection of cultivars. At the time of the trials, only two cultivars were available, one imported from Brazil, the other from a domestic source (no longer available except by special order). Despite the difficulty in obtaining seeds, culture of jilo is not difficult and demand among former South American (notably Brazilian) residents is great. Either cultivar used in the trials grows well in Connecticut's soils and climate, except during droughty periods.

Planting date. For optimum yields, transplants were set in the field between May 25 and June 5. Since plants grow rapidly when the soils are warm, earlier transplanting leads only to very slow growth and does not produce earlier yields. Jilo is harvested continuously throughout the summer and early fall as plants become taller and have more branches.

Plant spacing. In 1998, the plants were spaced 2 feet apart in rows 3 feet apart. In 1999 and 2000, the space between the rows was increased to 4 feet to allow easier harvesting. In rows 3 feet apart, branches of plants in adjacent rows became intermixed.

Mulching. Rows mulched with black plastic film warm the soil faster than unmulched rows. Mulch increased yield, promoted earlier yield, controlled weeds, and conserved nutrients.

Irrigation. During droughty periods, moisture stress caused flowers to abort with little or no fruit set. The effect of drought was amply demonstrated in dry 1999. During the growing season, at least 1 inch of water each week from rainfall or irrigation should promote fruit set.

Insects and diseases. During the 3 years of trials, jilo was virtually free of insects. As a member of the Solanaceous family, jilo can attract Colorado potato beetles. In 1998, a few were observed at Mt. Carmel feeding on the foliage. In

dry 1999, some plants at Mt. Carmel developed symptoms of verticillium wilt late in the season. In 2000, all plants were free of insects and diseases at both sites.

Harvest. The fruit were harvested at weekly intervals in the immature green stage when they reached about 2-3 inches in length. If harvest is delayed, the fruit begins to mature and becomes more bitter. Some customers, however, preferred riper fruit. If the harvest is delayed more than 1 week, the fruit enlarge and become too heavy for the stems to bear. To avoid breaking of lower stems, they may be lightened by more frequent picking.

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